Course Outline for 295 (Special Topics)—Complex Networks
University of Vermont, Spring 2008

Lecture room and meeting times:
220 Votey, Tuesday and Thursday, 9:30 am to 10:45 am

Instructor: Prof. Peter Dodds
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Office hours: (tentative) 11:00 am to 12:30 am, Tuesdays
Course website: `http://www.uvm.edu/~pdodds/teaching/2008-01UVM-295/`
Text: Journal papers to be assigned.

Synopsis: Complex networks crucially underpin much of the real and synthetic world Networks distribute and redistribute information, water, food, and energy. Networks can be constituted by physical pipes, embodied in relationships carried in people's minds, or manifested by economic interdependencies.

In the past decade, building on work in a wide range of disciplines, many (but certainly not all) advances have been made in understanding all manner of complex networks such as the World Wide Web, social and organizational networks, biochemical networks, and transportation networks. In this special topics course, we will explore this evolving field of complex networks by reading and discussing seminal and recent papers, and developing mathematical and algorithmic results where they exist.

The level will be graduate/advanced undergraduate.

Topics to be covered (more or less): Structure and form of complex networks including physical branching networks (river networks and cardiovascular networks), neural networks, social networks, the Internet, the world wide web, transportation networks, and organizations; distribution versus redistribution networks; properties of networks including degree distributions, clustering, motifs, various measures of betweenness, modularity, the role of randomness, network dynamics, and multiscale structures; community detection algorithms; bipartite networks; partly random networks as models of real world networks; generating function techniques; universal models including scale-free networks, p-star networks, and generative models; small-world networks; impedance and flow in networks; connections between delivery networks and energy usage in organisms; search in networks as facilitated by network structure and search methods; folksonomy and tagging; generalized notions of contagion in networks; network epidemiology and fad spreading; computation considerations for analysing networks.

Prerequisites: Familiarity with differential equations, difference equations, standard calculus, linear algebra, and statistical methods.

Computing: Proficiency in coding (C, Matlab, perl, python) will be beneficial (and indeed necessary) for certain projects but is not required.

Grading breakdown:

1. **Projects/talks (60%)**—Students will work on semester-long projects. Students will develop a proposal in the first few weeks of the course which will be discussed with the instructor for approval. A list of possible projects will be provided though individuals are encouraged and free to choose their own. Project content may range from novel research to a review of research relevant to the course. For the former, the hope here is for some work to percolate up to the level of journal publications.

   Students will give one introductory presentation in the fourth week of the semester and a longer one at the end. We will probably have 5 minutes for the first talk (plus around 10 minutes of discussion), and 15 to 20 for the final talk (exact length of talks will depend on class size). The goal of the first talk is to outline the project, explaining what it is, why it's interesting, and what you plan to do. The final talk should recap the project and then cover what was achieved. Projects are not expected to be amazing successes, and explaining approaches that failed and why they failed (if illuminating) is an acceptable part of the final talk.

   Students will also be required to hand in a report on their investigations. Reports should be written in the style of a journal paper (title, abstract, appropriate sections, bibliography, and appendices) and be at least 5 single-spaced pages.

   The grade breakdown will be 20% for the first talk, 20% for the final talk, and 20% for the written project.

2. **Assignments (35%)**—All assignments will be of equal weight and there will be approximately four of them. Clarity in writing and presentation will be taken into account in grading.

3. **General attendance/Class participation (5%)**—it is highly desirable that students attend class, and class presence will be taken into account if a grade is borderline.

4. **Attendance of office hours (0%)**—students are requested to attend at least one session of office hours during the course (again, the borderline grade issue is to be kept in mind here).

   In general, questions are worth 3 points according to the following scale:

- 3 = correct or very nearly so.
- 2 = acceptable but needs some revisions.
- 1 = needs major revisions.
- 0 = way off.

5. The course is a 3 credit course and is aimed at graduates and advanced undergraduates.

Schedule:

Week number (dates)	Tuesday	Thursday
1 (1/15 and 1/17)	lecture	lecture
2 (1/22 and 1/24)	lecture	lecture
3 (1/29 and 1/31)	lecture	lecture
4 (2/5 and 2/7)	project presentations[†]	project presentations[†]
5 (2/12 and 2/14)	lecture	lecture
6 (2/19 and 2/21)	lecture	lecture
7 (2/26 and 2/28)	lecture	lecture
8 (3/4 and 3/6)	Town Meeting Day	guest lecture
9 (3/11 and 3/13)	Spring Recess	Spring Recess
10 (3/18 and 3/20)	lecture	lecture
11 (3/25 and 3/27)	lecture	lecture
12 (4/1 and 4/3)	lecture	lecture
13 (4/8 and 4/10)	lecture	lecture
14 (4/15 and 4/17)	lecture	project presentations[‡]
15 (4/22 and 4/24)	guest lecture	project presentations[‡]
16 (4/29)	project presentations[‡]	—

†: ≈ 5 minutes each; ‡: 15–20 minutes each

Do check your zoo account for updates regarding the course.

Academic assistance: Anyone who requires assistance in any way (as per the ACCESS program or due to athletic endeavors), please see or contact me as soon as possible.

Being good people: First, in class there will be no electronic gadgetry, no cell phones, no beeping, no text messaging, etc. Second, I encourage you to email me questions, ideas, comments, etc., about the class but request that you please do so in a respectful fashion. Finally, as in all UVM classes, **Academic honesty** will be expected and departures will be dealt with appropriately. See `http://www.uvm.edu/cses/` for guidelines.

Late policy: Unless in the case of an emergency (a real one) or if an absence has been predeclared and a make-up version sorted out, assignments that are not turned in on time or tests that are not attended will be given 0%.

Grades:

A+	97–100	B+	87–89	C+	77–79	D+	67–69
A	93–96	B	83–86	C	73–76	D	63–66
A-	90–92	B-	80–82	C-	70–72	D-	60–62